

Lesson 2: Multiplication of Numbers in Exponential Form

Classwork

In general, if x is any number and m, n are positive integers, then

$$x^m \cdot x^n = x^{m+n}$$

because

$$x^m \times x^n = \underbrace{(x \cdots x)}_{m \text{ times}} \times \underbrace{(x \cdots x)}_{n \text{ times}} = \underbrace{(x \cdots x)}_{m+n \text{ times}} = x^{m+n}$$

Exercise 1

$$14^{23} \times 14^8 =$$

Exercise 2

$$(-72)^{10} \times (-72)^{13} =$$

Exercise 3

$$5^{94} \times 5^{78} =$$

Exercise 4

$$(-3)^9 \times (-3)^5 =$$

Exercise 5

Let a be a number.

$$a^{23} \cdot a^8 =$$

Exercise 6

Let f be a number.

$$f^{10} \cdot f^{13} =$$

Exercise 7

Let b be a number.

$$b^{94} \cdot b^{78} =$$

Exercise 8

Let x be a positive integer. If $(-3)^9 \times (-3)^x = (-3)^{14}$, what is x ?

What would happen if there were more terms with the same base? Write an equivalent expression for each problem.

Exercise 9

$$9^4 \times 9^6 \times 9^{13} =$$

Exercise 10

$$2^3 \times 2^5 \times 2^7 \times 2^9 =$$

Can the following expressions be simplified? If so, write an equivalent expression. If not, explain why not.

Exercise 11

$$6^5 \times 4^9 \times 4^3 \times 6^{14} =$$

Exercise 14

$$2^4 \times 8^2 = 2^4 \times 2^6 =$$

Exercise 12

$$(-4)^2 \cdot 17^5 \cdot (-4)^3 \cdot 17^7 =$$

Exercise 15

$$3^7 \times 9 =$$

Exercise 13

$$15^2 \cdot 7^2 \cdot 15 \cdot 7^4 =$$

Exercise 16

$$5^4 \times 2^{11} =$$

Exercise 17

Let x be a number. Simplify the expression of the following number:

$$(2x^3)(17x^7) =$$

Exercise 18

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$$a(a + b) =$$

Exercise 19

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$$b(a + b) =$$

Exercise 20

Let a and b be numbers. Use the distributive law to simplify the expression of the following number:

$$(a + b)(a + b) =$$

In general, if x is nonzero and m, n are positive integers, then

$$\frac{x^m}{x^n} = x^{m-n} \quad \text{if } m > n$$

Exercise 21

$$\frac{7^9}{7^6} =$$

Exercise 23

$$\frac{\left(\frac{8}{5}\right)^9}{\left(\frac{8}{5}\right)^2} =$$

Exercise 22

$$\frac{(-5)^{16}}{(-5)^7} =$$

Exercise 24

$$\frac{13^5}{13^4} =$$

Exercise 25

Let a, b be nonzero numbers. What is the following number?

$$\frac{\left(\frac{a}{b}\right)^9}{\left(\frac{a}{b}\right)^2} =$$

Exercise 26

Let x be a nonzero number. What is the following number?

$$\frac{x^5}{x^4} =$$

Can the following expressions be simplified? If yes, write an equivalent expression for each problem. If not, explain why not.

Exercise 27

$$\frac{2^7}{4^2} = \frac{2^7}{2^4} =$$

Lesson 29

$$\frac{3^5 \cdot 2^8}{3^2 \cdot 2^3} =$$

Exercise 28

$$\frac{3^{23}}{27} = \frac{3^{23}}{3^3} =$$

Lesson 30

$$\frac{(-2)^7 \cdot 95^5}{(-2)^5 \cdot 95^4} =$$

Exercise 31

Let x be a number. Simplify the expression of each of the following numbers:

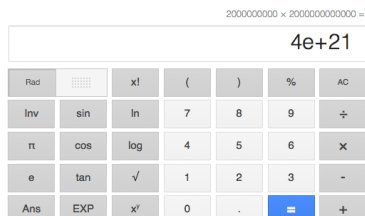
1. $\frac{5}{x^3}(3x^8) =$

2. $\frac{5}{x^3}(-4x^6) =$

3. $\frac{5}{x^3}(11x^4) =$

Exercise 32

Anne used an online calculator to multiply $2,000,000,000 \times 2,000,000,000,000$. The answer showed up on the calculator as $4e + 21$, as shown below. Is the answer on the calculator correct? How do you know?



Problem Set

1. A certain ball is dropped from a height of x feet, it always bounces up to $\frac{2}{3}x$ feet. Suppose the ball is dropped from 10 feet and is caught exactly when it touches the ground after the 30th bounce, what is the total distance traveled by the ball? Express your answer in exponential notation.

Bounce	Computation of Distance Traveled in Previous Bounce	Total Distance Traveled (in feet)
1		
2		
3		
4		
30		
n		

2. If the same ball is dropped from 10 feet and is caught exactly at the highest point after the 25th bounce, what is the total distance traveled by the ball? Use what you learned from the last problem.
3. Let a and b be numbers and $b \neq 0$, and let m and n be positive integers. Simplify each of the following expressions as much as possible:

$(-19)^5 \cdot (-19)^{11} =$	$2.7^5 \times 2.7^3 =$
$\frac{7^{10}}{7^3} =$	$\left(\frac{1}{5}\right)^2 \cdot \left(\frac{1}{5}\right)^{15} =$
$\left(-\frac{9}{7}\right)^m \cdot \left(-\frac{9}{7}\right)^n =$	$\frac{ab^3}{b^2} =$

4. Let the dimensions of a rectangle be $(4 \times (871209)^5 + 3 \times 49762105)$ ft. by $(7 \times (871209)^3 - (49762105)^4)$ ft. Determine the area of the rectangle. No need to expand all the powers.
5. A rectangular area of land is being sold off in smaller pieces. The total area of the land is 2^{15} square miles. The pieces being sold are 8^3 square miles in size. How many smaller pieces of land can be sold at the stated size? Compute the actual number of pieces.